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(54) Method of transmitting data in RDS broadcasting.

(57) A data transmitting method in the RDS broadcasting in which, when a data group of a group unit comprising four blocks is inserted into a radio broadcasting wave and transmitted, data is effectively inserted into each block and inserted data can be effectively used upon reception. According to the first feature, high order four digits and low order four digits of the PS data of at most eight digits are respectively transmitted as the data in the third and fourth blocks in each group, so that the broadcasting station name can be promptly displayed. As another feature, the PI code of the station itself is transmitted as the PI code in the first block in one group and, if a station which broadcasts a program different from the program of the station itself for only a predetermined time zone exists in the same network stations, the PI code of such a station is transmitted as the PI code in the third block.

FIG. 3A

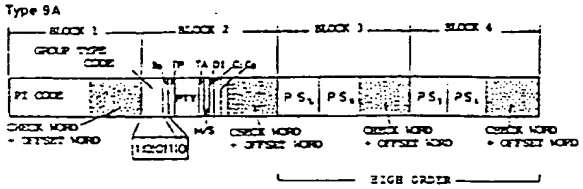
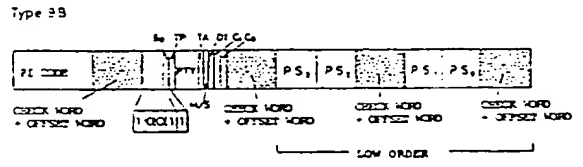


FIG. 3B



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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a method of transmitting data in the RDS broadcasting.

2. Description of Background Information

The RDS (Radio Data System) broadcasting is a broadcasting service in which, in the program broadcasting of a general broadcasting station, information relating to the broadcast such as information regarding the program content or the like is transmitted as data by a multiplex modulation. The transmitted data is demodulated on the reception side, so that a desired program content can be selected on the basis of the demodulated data, thereby services are offered to a radio listener.

In the RDS broadcasting, a signal of 57 kHz as a third harmonic of a stereo pilot signal of 19 kHz in a range out of a frequency band of a frequency modulated wave is used as a subcarrier. The subcarrier is amplitude modulated into a radio data signal by a data signal which is filtered and biphase coded carrying information regarding the broadcasting such as program content and the like, and the amplitude modulated subcarrier is frequency modulated into the main carrier for the broadcasting. Standards of the above broadcasting scheme were proposed by the European Broadcasting Union (EBU).

As will be obviously understood from Fig. 1 showing a base band coding structure of a radio data signal, in the radio data signal, data of 104 bits are processed as one group and are repetitively transmitted through a multiplex transmission. One group comprises four blocks each having 26 bits. Each block comprises an information word of 16 bits and a check word of 10 bits. Each group is classified into sixteen types, that is, Type 0 through Type 15 indicated by four bits according to the information content. Further, two versions A and B are defined for each of the types (0 to 15).

Figs. 2A and 2B show the format of groups of the types 0A and 0B, respectively. In the type 0A group, a PI code of 16 bits composed of a country code, a broadcasting range code, and a program code is arranged in a block 1. Various codes such as group type code, version code (B_0), traffic information broadcasting station identification (TP) code, program content identification (PTY) code, and the like are arranged in a block 2. Station frequency data (hereinafter, abbreviated as AF data) of network stations broadcasting the same program is arranged in a block 3. Broadcasting station name data (hereinafter, abbreviated as PS data) is arranged in a block 4. On the other hand, in the type 0B group (shown in Fig. 2B), only the content of the block 3 differs from that in the type 0A group. Specifically, the PI code is arranged in the block 3. That is, the AF data of the network stations is transmitted by only the type 0A group. The PS data is transmitted by the type 0A and 0B groups.

As mentioned above, the AF data of the network stations which broadcast the same program as the program of the broadcasting station which is at present being received is also included in the radio data signal of the type 0A group. At the time of the reception, the AF data and PI code which are obtained by the demodulation are retrieved and stored as an AF list. For instance, in the case where a receiving strength of the broadcasting station of the program which is at present being received isdecreased due to a disturbance such as a multipath interference or the like, another station in the same network stations is selected on the basis of the AF list which has previously been stored. Further, a check is made to see if the program which was received in accordance with the AF list is correct or not by comparing the PI codes. Thus, the same program can be listened always in a good receiving state without being influenced by external disturbances.

On the other hand, the broadcasting station name is expressed by at most eight alphabet letters. As will be readily understood from Figs. 2A and 2B, as the PS data of at most eight digits indicative of the broadcasting station name, in the type 0A or 0B group, the data of two letters (8 bits × 2) is transmitted on a group unit basis. By transmitting the radio data signal of four groups, the data of eight letters is transmitted. To which number of PS data in eight letters the PS data in the group which is being transmitted belongs can be known by checking the content of PS address codes (C_1, C_0) in the block 2. The transmitted PS data-is demodulated on the reception side and is displayed as a broadcasting station name by up to eight alphabet letters.

As mentioned above, in the RDS broadcasting method proposed by the EBU, the PS data is transmitted every two letters for four groups on the basis of the type 0A or 00 group. Therefore, if the PS addresses in the block 2 are wrong, start of the display of the broadcasting station name by the PS data of up to eight digits will be delayed, for example. In a free station or the like which doesn't have a station frequency list (AF list) of the network stations, in the case of the type 0A group, the data transmitting ratio decreases because the AF data to be transmitted in the block 3 does not exist.

In the same network station, these can exist a station which broadcasts a different program for only a certain time zone (or time period) so as to

temporarily switch from the national network broadcasting to a local broadcasting. In such a station, in order to distinguish from the other stations in the same network stations, the PI code (for instance, a part of the code) is changed for only such a time zone.

Now, the PI code transmitted by the station which always performs the national network broadcasting is expressed by PI. On the other hand the PI code transmitted for only a certain time zone by the station which performes a local broadcasting for only such a time zone is expressed by PI'. It is now assumed that the program of the station of the PI code of PI' is being received. When the program of the station of PI' is being received, for instance, if a broadcasting region has changed as the movement of the vehicle, it will result in the deterioration of the receiving state of the PI' station. At this time, as mentioned above, another PI' station is selected on the basis of the AF list by comparing the PI' codes. However, there can be a case where a PI' station of a good receiving state doesn't exist or cannot be found out. In such a case, since the PI' codes have already been compared, it is also impossible to shift to another PI station in the same network stations.

OBJECTS AND SUMMARY OF THE INVENTION

The present invention is based on the recognition of the drawbacks described in the foregoing and it is an object of the invention to provide a data transmitting method in the RDS broadcasting in which, when the data group in the form of the group unit comprising four blocks is transmitted while being inserted into a radio broadcasting wave and transmitted, data is effectively inserted into each block, and upon reception, the inserted data can be effectively utilized.

Another object of the invention is to provide a method of transmitting broadcasting station name data in the RDS broadcasting, in which the broadcasting station name can be promptly displayed on the reception side and even in a free station or the like having no AF list, without reducing the data transmitting ratio.

Still another object of the invention is to provide a method of transmitting a PI code in the RDS broadcasting in which at the time of the reception of a local broadcasting for example, when the receiving state deteriorates, another station in the same network stations can be received even if another station of the same local broadcasting cannot be received.

According to the present invention there is provided a method of transmitting a broadcasting station name, in an RDS broadcasting in which a data group comprising four blocks is treated as one group and the data group of the group unit is repetitively inserted into a radio broadcasting wave for the transmission, the transmitting method transmitting broadcasting station name data of up to eight digits indicative of the broadcasting station name which is expressed by up to eight letters. The broadcasting station name data is separated into the data of high order four digits and the data of low order four digits, the data of the high order four digits is used as the data of the third and fourth blocks in one group, the data of the low order four digits is used as the data of the third and fourth blocks in another group, and those data are respectively transmitted. ID information indicating to which one of the high order and low order data the containing data of each group belongs is inserted into the second block of each group.

In the method of transmitting the broadcasting station name data according to the invention, the broadcasting station name data of up to eight digits is transmitted as the data of the third and fourth blocks in each group every four high order digits and four low order digits, respectively. On the reception side, upon reception of such a special group, a check is made to see if the received data relates to the data of the upper four digits or the data of the low order four digits. Each data is demodulated, so that the broadcasting station name is displayed.

A PI code transmitting method is provided according to the invention, in an RDS broadcasting in which a group of data comprising four blocks is treated as one group and the data group of such a group unit is repetitively inserted into a radio broadcasting wave for the transmition, the method inserting PI codes of the same network stations into the first and third blocks in one and transmitted, whereby the PI code of the station itself is transmitted as a PI code of the first block. If the station which broadcasts a program different from the program of the station itself for only a predetermined time zone exists in the same network stations, the PI code of such a station is transmitted as a PI code of the third block.

According to the PI code transmitting method of the invention, for the transmission of the PI codes of the same network stations inserted into the first and third blocks in one group, the PI code of the station itself is transmitted as the PI code of the first block, and if the station which broadcasts a program different from the program of the station itself for only a predetermined time zone exists in the same network stations, the PI code of such a station is transmitted as the PI code of the third block. At the time of the reception, the PI codes of the first and third blocks are retrieved and stored and either one of the PI codes is compared with the received PI code. Therefore, even if the station

which is at present broadcasting the same program as that of the station itself cannot be selected, another station in the same network stations is selected.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. I is a diagram showing a base band coding structure of radio data;

Figs. 2A and 2B are diagrams showing formats of group types 0A and 0e, respectively;

Figs. 3A and 3B are diagrams showing formats of group types 9A and 9B to which a transmitting method of broadcasting station name data according to the invention is applied, respectively;

Fig. 4 is a block diagram showing an example of a fundamental construction of an RDS receiver;

Fig. 5 is a flowchart showing an embodiment of a processing procedure of PS data;

Fig. 6 is a flowchart showing a part of the embodiment of the processing procedure of the PS data;

Figs. 7A and 7B are diagrams showing formats of a radio data signal corresponding to the group type 0s to which a PI code transmitting method according to the invention is applied;

Fig. 8 is a block diagram showing another example of a fundamental construction of the RDS receiver;

Fig. 9 is a flowchart showing an embodiment of a processing procedure upon selection of a station based on the PI code; and

Fig. 10 is a flowchart showing another embodiment of the processing procedure upon selection of a station based on the PI code.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

An embodiment of the present invention will be described in detail hereinafter with reference to the drawings.

Figs. 3A and 3B are diagrams showing the format of two kinds of radio data signals to which the transmitting method of broadcasting station name data according to the invention is applied. Each of the two kinds of radio data signals has the same base band coding structure as that of the conventional example. One hundred and four (104) bits are set to one group. One group comprises four blocks each consisting of 26 bits. Each block comprises an information word of 16 bits and a check word of 10 bits and is used to transmit PS data. Therefore, the two kinds of radio data signals have format constructions corresponding to the group types 0A and 0B shown in Figs. 2A and 2B. It is now assumed that the group types are set to, for instance, 9A and 9B.

Upon transmission of the PS data of up to eight digits, the PS data is divided into the data of high order four digits and the data of low order four digits. The PS data (PS_7 to PS_4) of the high order four digits is transmitted by the type 9A group. The PS data (PS_3 to PS_0) of the low order four digits is transmitted by the type 9B group. In each group, the PS data of four digits is arranged in the blocks 3 and 4 every two digits, respectively. The group type is discriminated by the group type code arranged in the block 2 in a manner similar to the conventional method. On the other hand, discrimination regarding the high order or low order digits of the PS data is performed by discriminating a version A or B on the basis of a version code (B_0) arranged in the block 2. Since the high order or low order digits of the PS data can be discriminated by the version code (B_0), in the case of considering the correspondence between the group types 0A and 0B. The PS address codes (C_1, C_0) arranged in the blocks 2 in the group types 0A and 0B are unnecessary. Therefore, those two bits can be used to transmit another data.

Fig. 4 shows an example of a fundamental construction of the RDS receiver. In the diagram, an FM multiplexed broadcasting wave which was received by an antenna I is input to a front-end 2, by which a desired station is selected and the signal of the selected station is converted into an intermediate frequency (IF). After that, the signal is supplied through an IF amplifier 3 to an FM detector 4. For instance, the front-end 2 employs a PLL synthesizer system using a PLL circuit including a programmable frequency divider. A frequency dividing ratio of the programmable frequency divider is controlled by a controller 13, which will be explained later, so that a station selecting operation is performed. A detection output of the FM detector 4 is supplied to an MPX (multiplex) demodulating circuit 5 and is separated into audio signals of the L (left) and R (right) channels in the case of a stereophonic broadcasting.

On the other hand, by transmitting the detection output of the FM detector 4 through a filter 6, a subcarrier of 57 kHz, which is amplitude modulated by a biphase coded data signal, that is a radio data signal is extracted and is demodulated by a PLL circuit 7. The demodulated output is supplied to a digital the PLL circuit 8 and a decoder 9. In the D-PLL circuit 8, clocks for data demodulation are produced on the basis of the demodulated output of the PLL circuit 7. In the decoder 9, the biphase coded data signal as the demodulated output of the PLL circuit 7 is decoded synchronously with the clocks produced by the D-PLL circuit 8. A locking state detecting circuit 10 detects locking and unlocking states of the D-PLL circuit 8. Locking ranges

of the PLL circuit 7 and D-PLL circuit 8 are switched by a detection output of the detecting circuit 10.

Output data of the decoder 9 has the group unit of 104 bits comprising four blocks each consisting of 26 bits as shown in Fig. 1 and is sequentially supplied to a group/block sync & error detecting circuit 11. In the detecting circuit 11, synchronization between the group and the block is performed on the basis of an offset word of 10 bits which were respectively assigned to the check word of 10 bits of each block. Further, errors in the information word of 16 bits are detected on the basis of the check word. The error detected data is error corrected by an error correcting circuit 12 at the next stage and, thereafter, it is supplied to the controller 13.

The controller 13 is constructed by a microcomputer and fetches code information of each block in the radio data which is sequentially input on a group unit basis, that is, radio information regarding the program content of the broadcasting station which is at present being received and stores into the RAM 14. The controller 13 executes a station selecting operation by controlling a frequency dividing ratio of the programmable frequency divider (not shown) of the PLL circuit constituting a part of the front-end 2 on the basis of a station selection command from an operating section 15. The receiving frequency of the selected station is stored into the RAM 14. A detection output of a level detecting circuit 16 for detecting that a signal intensity, namely, field intensity has decreased to a value of a set level or less on the basis of the IF signal level is also supplied to the controller 13. When the detection output or the level detecting circuit 16 is supplied, the controller 13 determines that a receiving state of the broadcasting station of the program which is at present being received deteriorated. Therefore, the controller 13 controls the frequency dividing ratio of the programmable frequency divider so as to select another network station on the basis of the as data of the network stations which have previously been stored in the RAM 14.

On the other hand, a matrix display device 17 which can display eight letters such as numerals, alphabet letters, etc., is connected to the controller 13 through a driving circuit 18. Character pattern data to be displayed by the display device 17 has previously been stored in a ROM 19. The character pattern data of a letter to be displayed is read out from the ROM 19 by the controller 13 and is loaded into a buffer (not shown) in the driving circuit 18, so that the corresponding letters are displayed by the display device 17.

A processing procedure of the PS data which is executed by the processor of the controller 13 will now be described in accordance with a flowchart of Fig. 5. This processing routine is accessed and executed when the process to select a desired station was finished.

After the completion of the selecting process of a desired station, the processor first fetches the output data of the decoder 9 (step S1). A check is made to see if the group type of the received radio data signal is "9" or not from the content of the group type code arranged in the block 2 (step S2). If the group type is not "9", the processing routine is finished.

If the group type of the received radio data signal is "9", the processor checks to see if the version of the group type 9 is equal to "A" or not from the content of the version code (B0) arranged in the block 2 (step S3). If the version is "A", the PS data in the Blocks 3 and 4 are fetched as the PS data (PS_7 to PS_4) of the high order four digits (step S4). If the version is set to D, the PS data in the blocks 3 and 4 are fetched as the PS data (PS_3 to PS_0) of the low order four digits (step S5). Then, the processor checks to see if the number n of PS data fetching times on a group unit basis has been set to 2 or not (step S6). If $n < 2$, the value of n is incremented By "+1" (step S7). After that, the processing routine is returned to step S3.

If $n = 2$, this means that both of the PS data of the high order and low order digits have been fetched. Therefore, the processor sets the PS data of the high order and low order digits which are fetched at this time into PS data D_N (step S8). Subsequently, a check is made to see if the number M of fetching times of the PS data D_N has been set to a predetermined value X (≥ 2) or not (step S9). If $N < X$, the value of N is incremented by "+1" (step S10). After that, the processing routine is returned to step S3 and the above processes are repeated. If $N = X$, the processor checks to see if all of the PS data D_1, ... D_N which have been fetched so far coincide or not (step S11). If any one of the PS data D_1, ..., D_N doesn't coincide, the value of M is reset to I (step S12). After that, the processing routine is returned to step S3 and the above processes are repeated. As mentioned above, by fetching the PS data M times and confirming that all of the PS data coincide, the reliability of the PS data can be raised.

If all of the PS data D_1, ..., D_N coincide, the processor writes the PS data into a predetermined memory area in the RAM 14 (step S13). After that, a PS display subroutine for displaying the broadcasting station name based on the PS data by the display device 17 is executed (step S14). In the PS display subroutine, the PS data stored in the RAM 14 is read out and the character pattern corresponding to the letter indicated by the PS data is read out of the ROM 19 and supplied to the driving

circuit 18. Due to this, the broadcasting station name is displayed by the display device 17. The display content is held until another station is selected.

The embodiment has been described above with respect to the case of discriminating the version A or B on the basis of the version code (B_0) arranged in the block 2 when discriminating whether the PS data is the data of the high order digits or the data of the low order digits.

However, two bits corresponding to the PS address codes (C_1 , C_0) in the blocks 2 in the group types 0A and 0B can be also used to discriminate the version A or B. For instance, it is defined such that the version A = C_1, C0 (0, 0) and the version B = C_1, C_0 (1, 1). Fig. 6 shows a part of a flowchart showing a processing procedure of the PS data in the above case.

In Fig. 6, the steps to execute the same processes as those in Fig. 5 are designated by the same reference numerals. If it is determined that the version has been set to A in step S3, the processor checks to see if (C_1, C0) = (1, 1) or not (step S21). Unless (C_1, C_0) = (1, 1), it is decided that the version has been set to A and step S4 follows. If (C_1, C_0) = (0, 0), it is obviously determined that the version is not set to A. The processing routine is finished. Similarly, if it is decided in step S3 that the version is set to D, the processor checks to see if (C_1, C_0) = or not (step S22). Unless (C_1, C0) = (0, 0), it is decided that the version is set to e and step S5 follows. If (C_1, C_0) = (0, 0), it is obviously determined that the version is not set to B and the processing routine is finished.

As mentioned above, the discrimination regarding the version A or B by two steps by also using two bits corresponding to the PS address codes (C_1, C_0) in the blocks 2 in the group types 0A and 0B, the discrimination about the version A or B, that is, the discrimination regarding whether the PS data is the data of the high order digits or the data of the low order digits can be more certainly performed. In the embodiment of Fig. 6, in step S21, even in the case where (C_1, C_0) = (1, 0) or (0, 1), it is determined that the version is set to A. However, since there is a possibility such that the above situation occurs due to errors of data, it is determined that the version is set to A so long as (C_1, C_0) are not equal to (1, 1), thereby permitting the data errors. Therefore, in the case where any data error is not permitted, a check is made in step S21 to see if (C_1, C0) = (0, 0) or not. It is sufficient to decide that the version is set to A only when (C_1, C_0) = (0, 0). The same shall also apply to the case of she version B.

As described above, according to the transmitting method of the broadcasting station name data of the invention, the PS data of up to eight digits is respectively transmitted as the data of the third and fourth blocks in each group every high order four digits and every low order four digits, so that on the reception side, upon reception of a special group, by merely checking to which one of the two groups of the versions A and B the special group belongs, the PS data of up to eight digits can be confirmed. Therefore, the broadcasting station name can be promptly displayed. Moreover, even in a free station or the like having no AF list, the data transmitting ratio does not decrease.

Another embodiment of the invention will now be described in detail with reference to the drawings.

Figs. 7A and 7B are diagrams showing formats of radio data signals to which the PI code transmitting method according to the invention was applied. Each of the radio data signal has the same base band coding structure as that of the conventional one. One hundred and four (104) bits are set to one group. One group comprises four blocks each consisting of 26 bits. Each block comprises an information word of 16 Bits and a check word of 10 bits. Each of the radio data signals has a format construction corresponding to the group type 0B shown in Fig. 2B.

In the case where a station which broadcasts a different program for only a certain time zone exists in the same network stations so as to temporarily switch from the national network broadcasting to a local broadcasting, the radio data signal is transmitted from each of the same network stations for such a time zone. The invention has a feature in the PI code transmitting method in the blocks I and 3 in one group. The PI code of the station itself is transmitted as the PI code of the block I. If a station which broadcasts a program different from the program of the station itself for only a certain time zone exists in the same network stations, the PI code of such a station is transmitted as the PI code of the block 3. In the cases other than the above case, the PI code in the block 3 is equalized to the PI code in the block I in a manner similar to the case of the group type 0B. That is, assuming that the PI code which is transmitted by the station which executes a national network broadcasting is set to PI and the PI code which is transmitted for a special time zone by the station which executes a local broadcasting is set to PI', in the station which performs the national network broadcasting, as shown in Fig. 7A, the transmission of the PI code is executed such that the PI code in the block I is set to PI and the PI code in the block 3 is set to PI'. In the station which performs the local broadcasting for only a certain time zone, the transmission of the PI code is executed such that the PI code in the block I is set to PI', and the PI code in the block 3

is set to PI as shown in Fig. 7B.

Fig. 8 shows another example of a fundamental construction of the RDS receiver.

The same parts and components as those shown in Fig. 4 are designated by the same reference numerals and their descriptions are omitted here.

The controller 13 is constructed by a microcomputer. The code information of each block in the radio data which are sequentially input on a group unit basis, that is, the radio data information such as PI code, AF data, PS data, and the like regarding the program content of the broadcasting station which is at present being received are fetched and stored into the memory 14. A frequency dividing ratio of the programmable frequency divider (not shown) of the pll circuit constructing a part of the front-end 2 is controlled on the basis of a station selection command from the operating unit 15, thereby executing a station selecting operation.

The level detecting circuit 16 to detect the reception signal level (electric field intensity) on the basis of the IF signal level in the IF amplifier 3 is provided. There is also provided a station detecting circuit 20 for detecting a reception station and outputting a station detection signal when the IF signal level in the IF amplifier 3 is equal to or higher than a predetermined level and a detection output level of what are called S curve characteristics in the FM detector 4 lies within a precetermined level range. The reception signal level which is detected by the level detecting circuit 16 and the station detection signal which is output from the station detecting circuit 17 are supplied to the controller 13.

A processing procedure upon station selection in the same network stations based on the PI code which is executed by the processor of the controller 13 will now be described with reference to a flowchart of Fig. 9. In a receiving state of a desired station, in the case where the PI codes in the blocks 1 and 3 in the radio data signals of the group type 0B are different from each other, that is, if a station which broadcasts a different program for a special time zone exists in the same network stations, the above processing routine is called and executed. On the other hand, it is assumed that the AF data which is obtained by demodulating the reception broadcasting wave has been retrieved and the AF list of the same network stations of the broadcasting station of the program which is at present being received has already been made in the memory 14.

The processor first discriminates whether a request to switch the station to another station in the same network stations exists or not (step S101). The switching request is generated in the case where, for instance, the reception signal level of the present receiving frequency is equal to or less than a set level. If the switching request has been generated, the processor fetches the PI codes (PI_1, PI_3) in the blocks 1 and 3 which are obtained from the broadcasting wave which is at present being received and the AF data of a receiving frequency f_d andholds into an accumulator or the like (step S102). After that, the AF data of 1 in the list is read out of the memory 14 in accordance with the foregoing AF list (step S103). By outputting the AF data to the PLL circuit (not shown) in the front-end 2, the tuning operation is performed (step S104). Subsequently, the processor fetches the PI code (PI_{AF}) in the block 1 which is obtained from the broadcasting wave of the new reception station (step S105). A check is made to see if the PI code (PI_{AF}) coincides with the PI code (PI_1) in the block 1 which was held in step S102 or not (step S106). If they coincide, the station frequency of the reception station is directly set to the new receiving frequency and the operating mode is shifted to the normal receiving mode. Due to this, if the reception station which has been received so far is the station which is executing, for instance, a local broadcasting, the broadcasting wave of the station which is executing the same local broadcasting can be subsequently received in the same network stations.

On the other hand, if it is determined in step S106 that the PI codes are different from eath other, the processor subsequently checks to see if the PI code (PI_{AF}) which is retrieved from the new reception broadcasting wave coincides with the PI code (PI_3)in the block 3 which was held in step S102 or not (step S107). If the codes coincide with each other, the station frequency of the reception station is directly set to a new receiving frequency and the operating mode is shifted to the normal receiving mode. Due to this, in the case where the reception station so far is a station which is performing the local broadcasting, even if a station which performs the same local broadcasting does not exist in the same network stations or cannot be found out, another station which is performing the national network broadcasting can be received in the same network station.

If it is also determined in step S107 that the PI codes differ, the processor checks to see if the comparison of the PI codes for the frequencies of all of the network stations has been finished or not (step S108). If the answer is NO, the processing routine is returned to step S103 and the above processes are repeated and the frequency of the same network stations which was first determined that the PI codes coincided in step S106 or S107 is set to the new receiving frequency. In the case where even after the comparison of the PI codes

was executed for the frequencies of all of the network stations, the station in which the PI code which coincides with the PI code (PI_1 or PI_3) in the block 1 or 3 is provided in the block 1 does not exist or cannot be found out, the AF data held in step S102 is accessed and the frequency is reset to the original receiving frequency f_d (step S109).

Fig. 10 is a flowchart showing a processing procedure upon station selection in the same network stations based on the PI code. The steps to execute the same processes as those in Fig. 9 are designated By the same reference numerals. In the embodiment, discrimination regarding whether the PI code (PI_{AF}) which was fetched from the new reception broadcasting wave coincides with the PI code (PI_1) in the block 1 which was held in step S102 or not is performed with respect to the frequencies of all of the network stations. Only in the case where the network station having the coincident PI code does not exist, discrimination regarding whether the PI code (PI_{AF}) which was fetched from the new reception broadcasting wave coincides with the PI code (PI_3) in the block 3 which was held in step S102 or not is executed for the frequencies of all of the network stations.

That is, the processor previously resets a flag F (F = 0) indicative of the end of the comparing process for the PI code (PI_1) in the block I after completion of the process in step S101 (step S110). After completion of the fetching of the PI code (PI_{AF}) in step S105, a check is made to see if the above flag F has been set (F = 1) or not (step S111). If F = 0, the comparing process to discriminate whether the PI code (PI_{AF}) coincides with the PI code (PI_1) in the block I or not is executed (step S106). If the PI codes are different from each other, a check is made to see if the comparison about the PI code (PI_1) for the frequencies of all of the network stations has been finished or not (step S112). If NO, the processing routine is returned to step S103 and the above processes are repeated. In the case where the station having the coincident PI code doesn't exist or cannot be found out even after completion of the comparison about the PI code (PI_1) for the frequencies of all of the network stations, the processor sets the the above flag F to I (step S113). After that, the processing routine is returned to step S103. If it is determined in step S111 that F = I, the processor executes the comparing process about the coincidence to the PI code (PI_3) in the block 3 (step S107). If the PI codes differ, a check is made to see if the comparison regarding the PI code (PI_3) for the frequencies of all of the network stations has been finished or not (step S108). If the answer is NO, the processing routine is returned to step S103 and the above processes are repeated.

As described above, according to the PI code transmitting method of the invention, when the PI code of the same network stations is inserted into the first and third blocks in one group and transmitted, the PI code of the station itself is transmitted as the PI code in the first block and, in the case where the station which broadcasts a program different from the program of the station itself for only a predetermined time zone exists in the same network stations, the PI code of such a station is transmitted as the PI code in the third block. Therefore, when receiving the PI code, the PI codes in the first and third blocks are fetched and stored and either one of the same network stations can be certainly selected by comparing either one of the PI codes in the first and third blocks and the reception PI code. Thus, for instance, when the receiving state deteriorated upon reception of the local broadcasting, even if the station of the same local broadcasting cannot be received, the broadcasting wave of another station in the same network stations can be received.

Claims

1. A transmitting method for transmitting broadcasting station name data indicative of a broadcasting station name expressed by at most eight letters in an RDS broadcasting in which a data group comprising four blocks is treated as one group and the data group at a group unit is repetitively inserted into a radio broadcasting wave for the transmission, characterized in that:

   the broadcasting station name data is separated into the data of high order four digits and the data of low order four digits, the data of the high order four digits is transmitted as the data in the third and fourth blocks in one group; the data of the low order four digits is transmitted as the data in the third and fourth blocks in another group; and ID information indicating one of the data of the high order four digits and the data of the low order four digits to which data contained in each group belongs to is inserted into the second block of each group.

2. A method according to claim 1, wherein said ID information is an ID code which is inserted in a position corresponding to the position of a version ID code in the second block in each group or the position of a PS address code in group types 0A or 0B.

3. A transmitting method of a PI code in an RDS broadcasting in which a data group comprising four blocks is treated as one group and the data group at a group unit is repetitively in-

serted into a radio broadcasting wave for the transmission, wherein a PI code of the same network stations is transmitted as being inserted into the first and third blocks in one group, characterized in that:

a PI code of the station itself is transmitted as a PI code in the first block, and

if another station which broadcasts a program different from a program of the station itself for only a predetermined time zone exists in the same network stations, a PI code of said another station is transmitted as a PI code in the third block.

FIG. 1

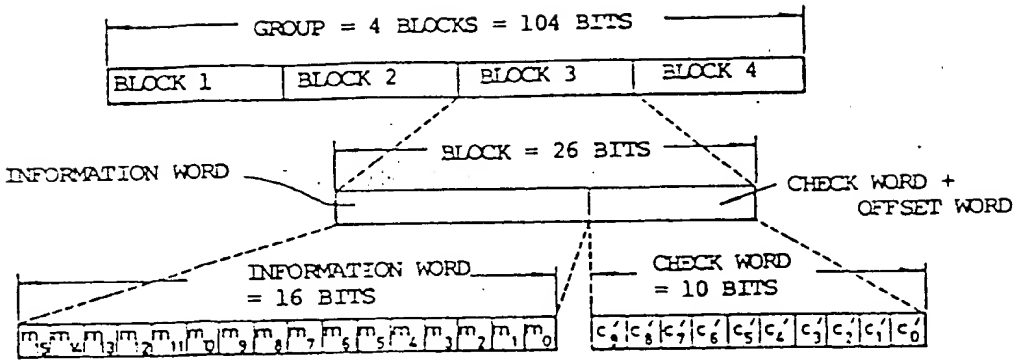

FIG. 2A
Type 0A

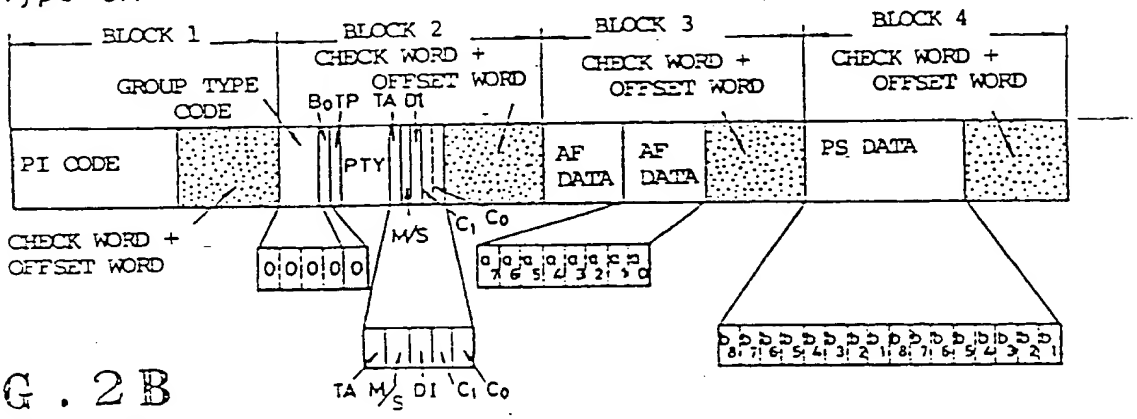

FIG. 2B
Type 0B

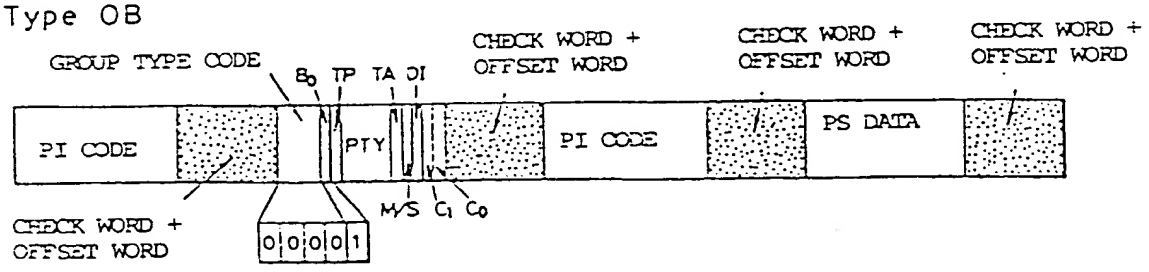

FIG. 3A

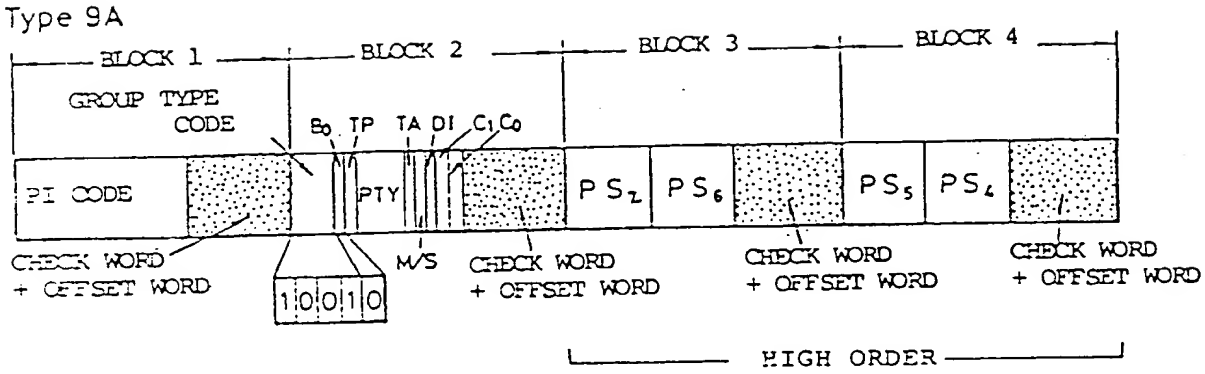
Type 9A
BLOCK 1
BLOCK 2
BLOCK 3
BLOCK 4
GROUP TYPE CODE
B0 TP TA DI C1 C0
PI CODE
PTY
PS2
PS6
PS5
PS4
CHECK WORD + OFFSET WORD
M/S
1 0 0 1 0
CHECK WORD + OFFSET WORD
CHECK WORD + OFFSET WORD
CHECK WORD + OFFSET WORD
HIGH ORDER

FIG. 3B

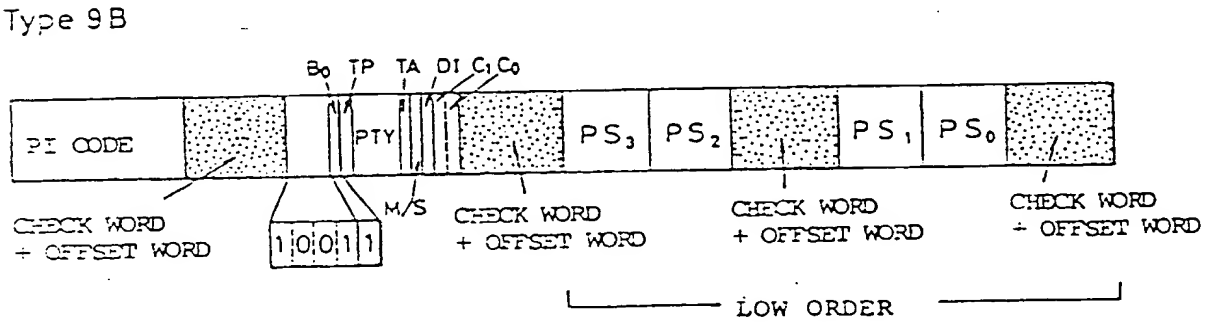
Type 9B
B0 TP TA DI C1 C0
PI CODE
PTY
PS3
PS2
PS1
PS0
CHECK WORD + OFFSET WORD
M/S
1 0 0 1 1
CHECK WORD + OFFSET WORD
CHECK WORD + OFFSET WORD
CHECK WORD + OFFSET WORD
LOW ORDER

FIG. 4

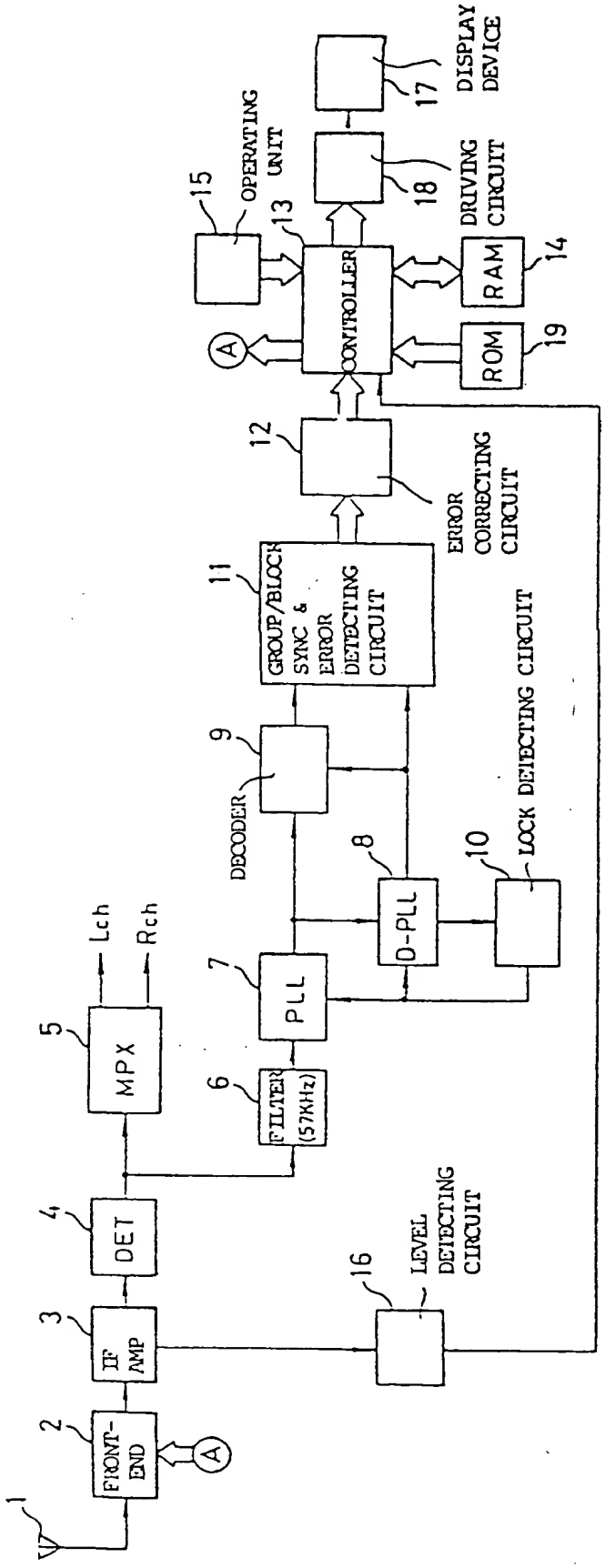
1
2
FRONT-END
3
IF AMP
4
DET
5
MPX
Lch
Rch
6
FILTER (57KHz)
7
PLL
8
D-PLL
9
DECODER
10
LOCK DETECTING CIRCUIT
11
GROUP/BLOCK SYNC & ERROR DETECTING CIRCUIT
12
ERROR CORRECTING CIRCUIT
13
CONTROLLER
14
RAM
15
OPERATING UNIT
16
LEVEL DETECTING CIRCUIT
17
DISPLAY DEVICE
18
DRIVING CIRCUIT
19
ROM
A
A

FIG. 5

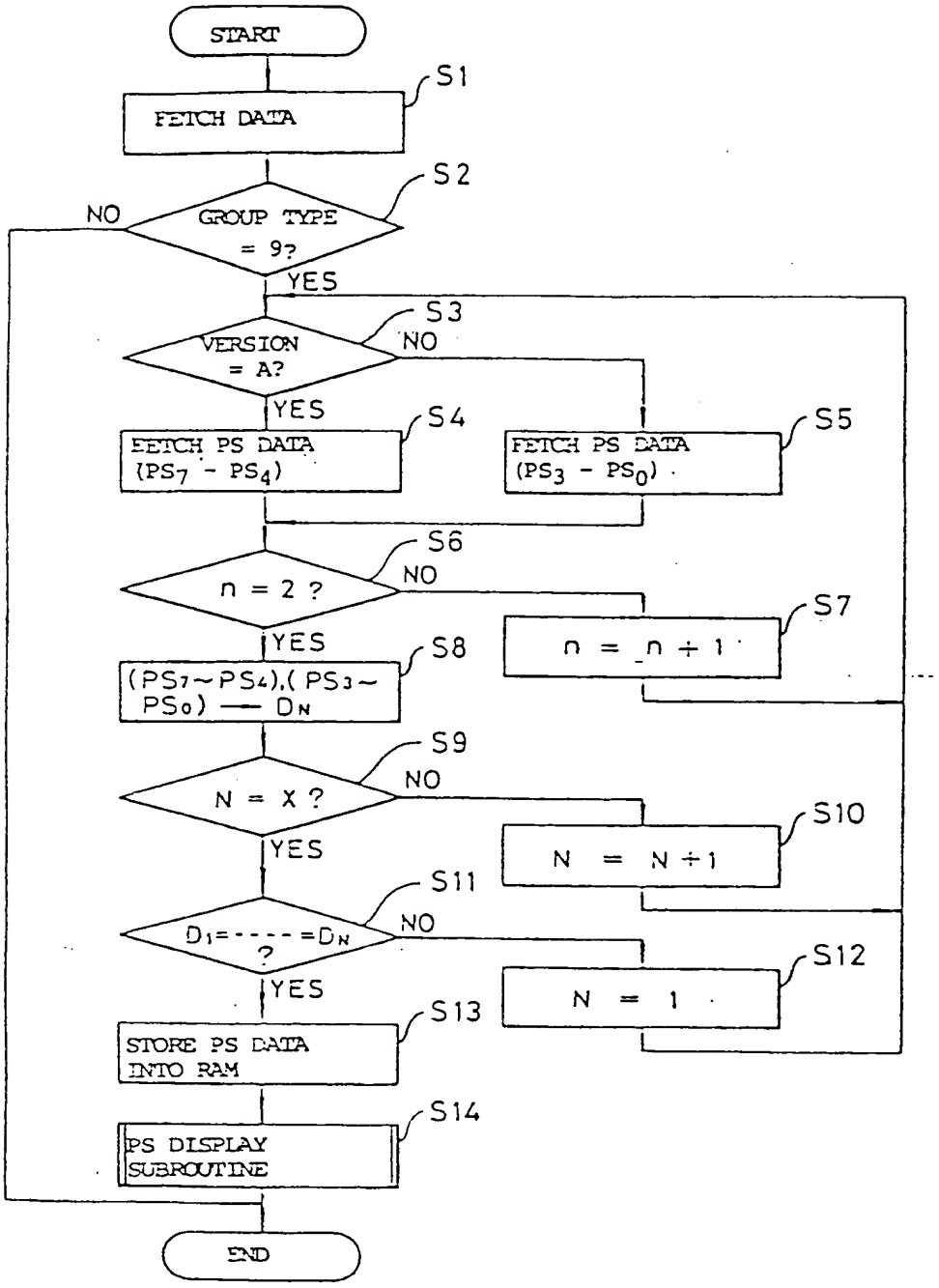
START
S1
FETCH DATA
S2
NO
GROUP TYPE = 9?
YES
S3
VERSION = A?
NO
YES
S4
FETCH PS DATA (PS7 - PS4)
S5
FETCH PS DATA (PS3 - PS0)
S6
n = 2 ?
NO
S7
n = n + 1
YES
S8
(PS7~PS4),(PS3~PS0) — DN
S9
N = X ?
NO
S10
N = N+1
YES
S11
D1=----=DN ?
NO
S12
N = 1
YES
S13
STORE PS DATA INTO RAM
S14
PS DISPLAY SUBROUTINE
END

FIG. 6

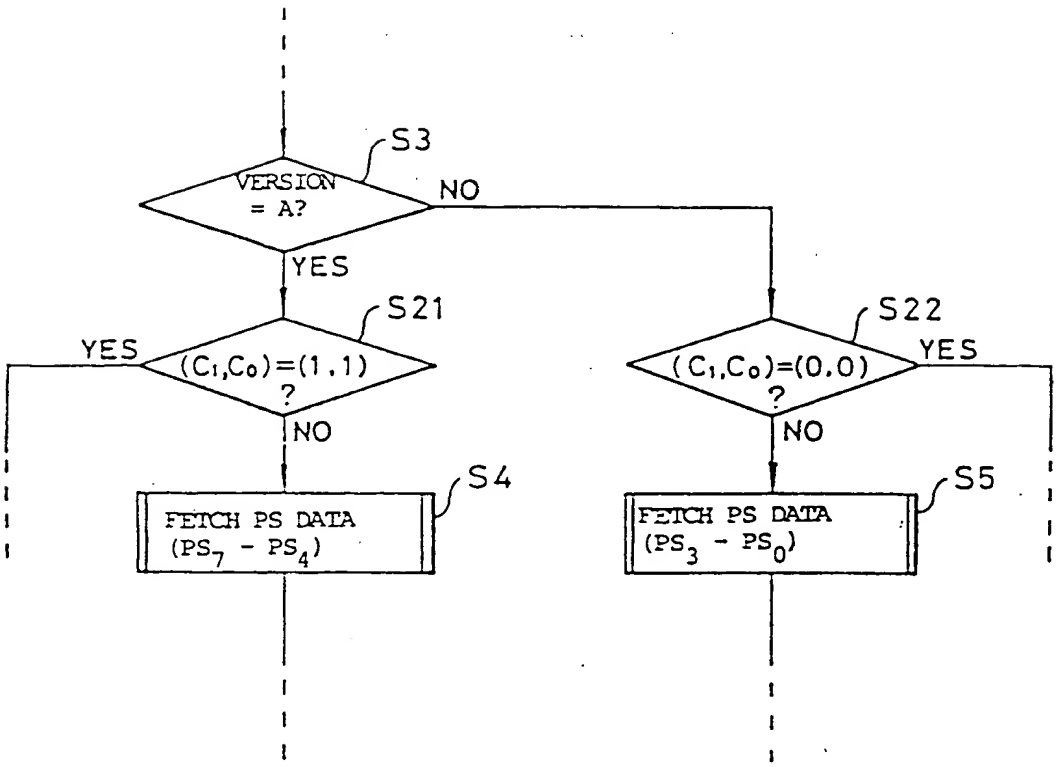
S3
VERSION = A?
NO
YES
S21
YES
(C1,C0)=(1,1) ?
NO
S4
FETCH PS DATA (PS7 - PS4)
S22
(C1,C0)=(0,0) ?
YES
NO
S5
FETCH PS DATA (PS3 - PS0)

FIG. 7A

IN THE CASE WHERE THE SELF STATION IS A STATION (PI) OF NATIONAL NETWORK BROADCASTING

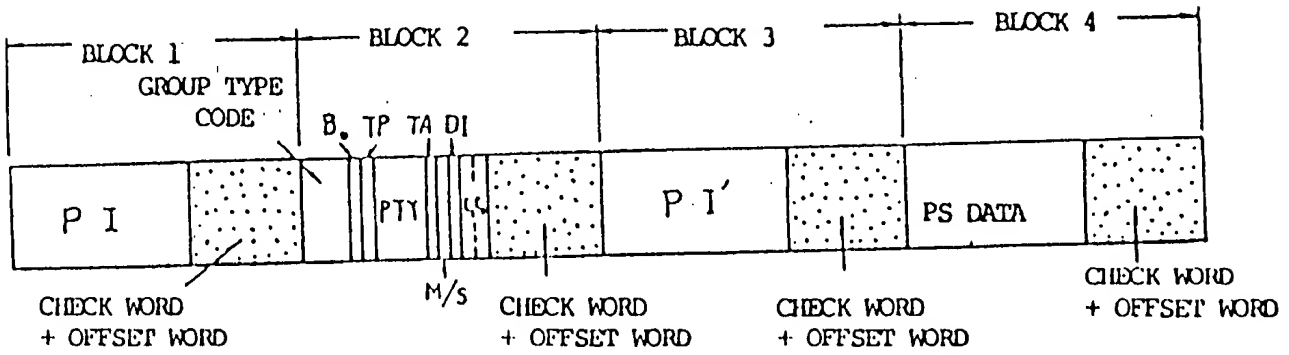

FIG. 7B

IN THE CASE WHERE THE SELF STATION IS A STATION (PI') OF LOCAL STATION

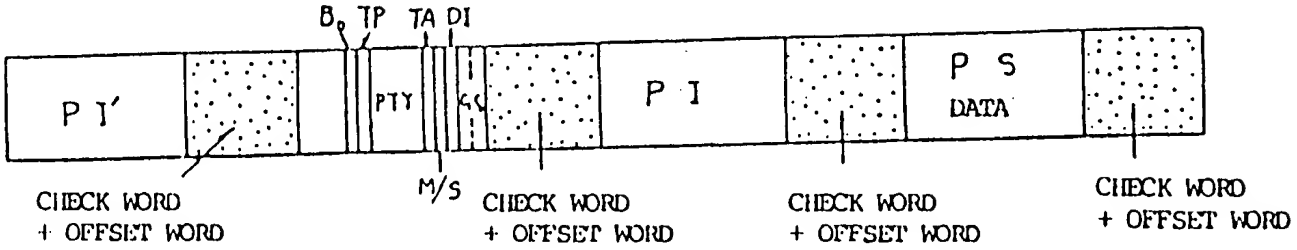

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FIG. 8

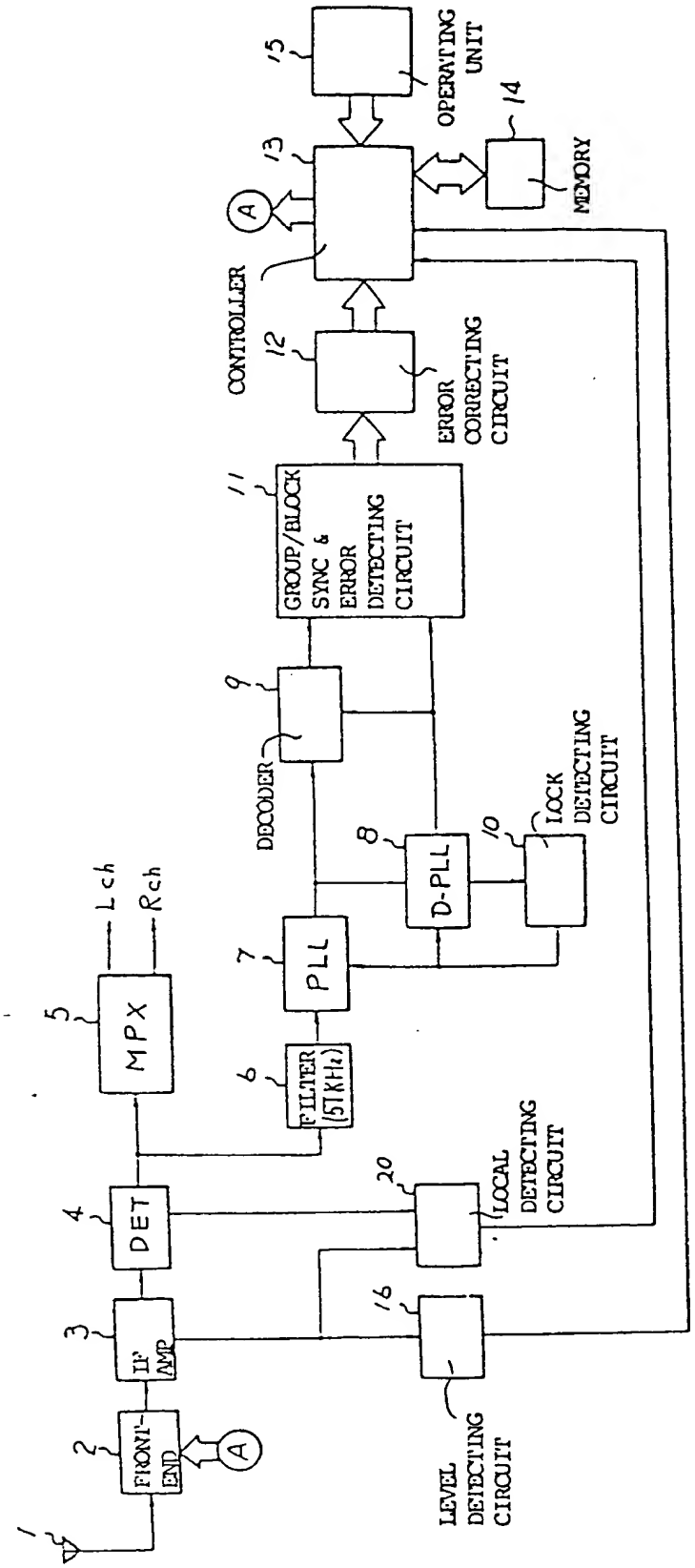

1
2
FRONT-END
A
3
IF AMP
4
DET
5
MPX
L ch
R ch
6
FILTER (57kHz)
7
PLL
8
D-PLL
9
DECODER
10
LOCK DETECTING CIRCUIT
11
GROUP/BLOCK SYNC & ERROR DETECTING CIRCUIT
12
ERROR CORRECTING CIRCUIT
13
CONTROLLER
A
14
MEMORY
15
OPERATING UNIT
16
LEVEL DETECTING CIRCUIT
20
LOCAL DETECTING CIRCUIT

FIG. 9

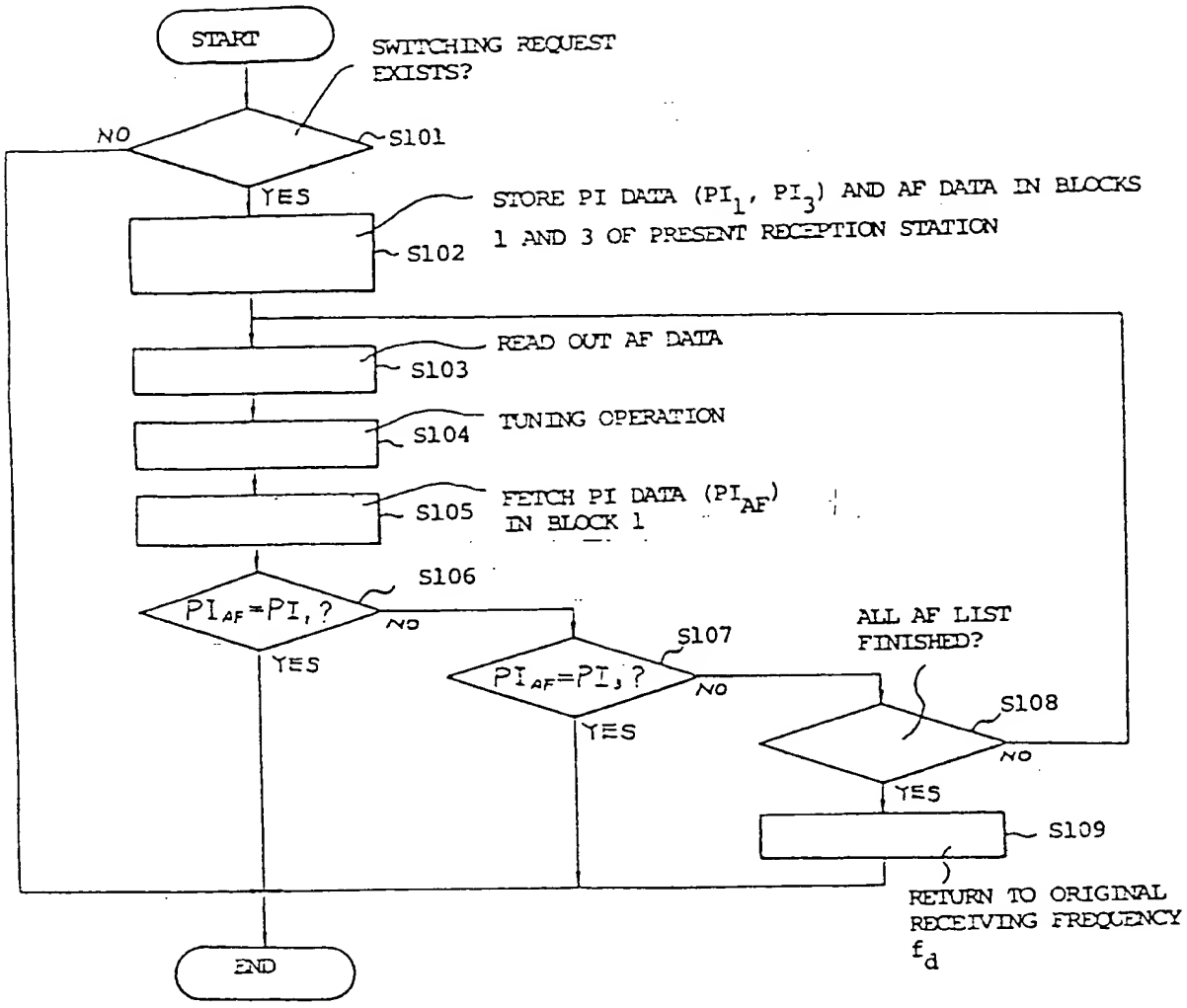
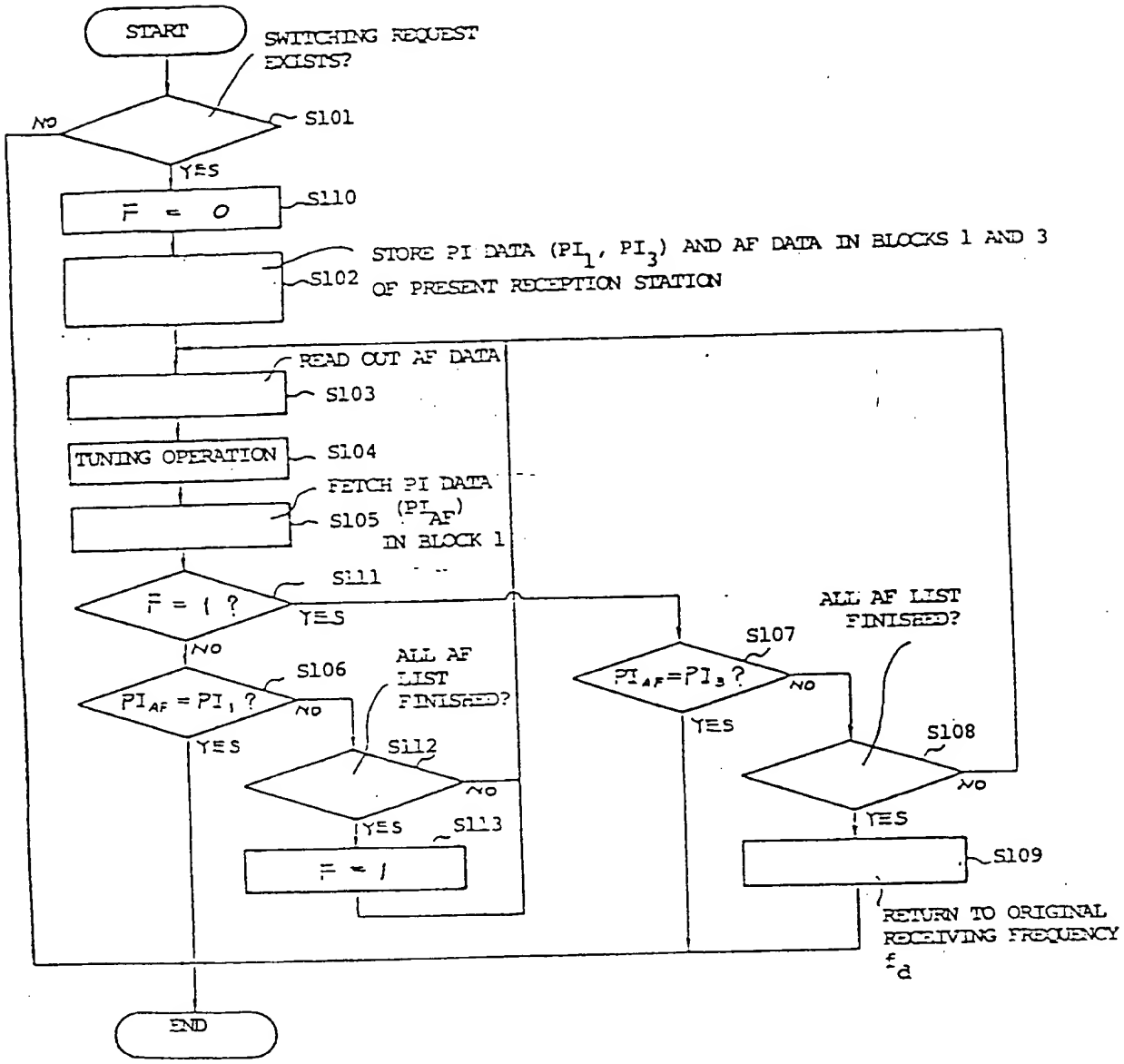

START
SWITCHING REQUEST EXISTS?
NO
S101
YES
STORE PI DATA (PI_1, PI_3) AND AF DATA IN BLOCKS 1 AND 3 OF PRESENT RECEPTION STATION
S102
READ OUT AF DATA
S103
TUNING OPERATION
S104
FETCH PI DATA (PI_{AF}) IN BLOCK 1
S105
S106
$PI_{AF}=PI_1$?
NO
YES
S107
$PI_{AF}=PI_3$?
NO
YES
ALL AF LIST FINISHED?
S108
NO
YES
S109
RETURN TO ORIGINAL RECEIVING FREQUENCY f_d
END

FIG. 10


START
SWITCHING REQUEST EXISTS?
S101
NO
YES
F = 0
S110
STORE PI DATA (PI_1, PI_3) AND AF DATA IN BLOCKS 1 AND 3 OF PRESENT RECEPTION STATION
S102
READ OUT AF DATA
S103
TUNING OPERATION
S104
FETCH PI DATA (PI_{AF}) IN BLOCK 1
S105
F = 1 ?
S111
YES
NO
$PI_{AF} = PI_1$?
S106
NO
YES
ALL AF LIST FINISHED?
S112
NO
YES
F = 1
S113
$PI_{AF} = PI_3$?
S107
NO
YES
ALL AF LIST FINISHED?
S108
NO
YES
S109
RETURN TO ORIGINAL RECEIVING FREQUENCY f_d
END

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(54) Method of transmitting data in RDS broadcasting.

(57) A data transmitting method in the RDS broadcasting in which, when a data group of a group unit comprising four blocks is inserted into a radio broadcasting wave and transmitted, data is effectively inserted into each block and inserted data can be effectively used upon reception. According to the first feature, high order four digits and low order four digits of the PS data of at most eight digits are respectively transmitted as the data in the third and fourth blocks in each group, so that the broadcasting station name can be promptly displayed. As another feature, the PI code of the station itself is transmitted as the PI code in the first block in one group and, if a station which broadcasts a program different from the program of the station itself for only a predetermined time zone exists in the same network stations, the PI code of such a station is transmitted as the PI code in the third block.

FIG.3A

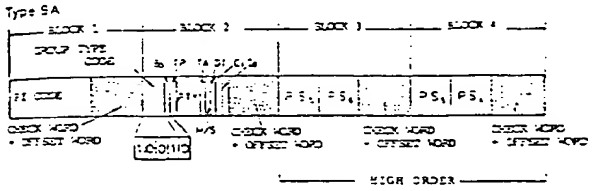
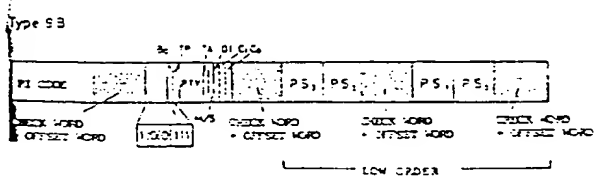


FIG.3B



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European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 10 0403

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	EUROPEAN BROADCASTING UNION, tech. 3244-E, March 1984, pages 1-60, Brussel, BE; "Specifications of the radio data system RDS for VHF/FM sound broadcasting" * Page 17, paragraph 1.3.1 * ---	1,2	H 04 H 1/00
A	PATENT ABSTRACTS OF JAPAN, vol. 13, no. 243 (E-768), 7th June 1989; & JP-A-01 044 630 (PIONEER ELECTRONIC CORP.) * Abstract * ---	1,2	
A	EP-A-0 305 172 (BRITISH BROADCASTING CORP.) * Page 2, line 32 - page 3, line 18 * ---	3	
A	WO-A-9 010 981 (N.V. PHILIPS' GLOEILAMPENFABRIEKEN) * Page 3, lines 7-33 * ---	3	
A	WO-A-9 007 237 (BRITISH BROADCASTING CORP.) * Claims * -----	3	TECHNICAL FIELDS SEARCHED (Int. Cl.5) H 04 H G 08 G H 03 J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11-12-1992	GASTALDI G.L.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P0401)

European Patent Office

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ All claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for all claims.

☐ Only part of the claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid.

namely claims:

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions.

namely:

see sheet -B-

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid.

namely claims:

☐ None of the further search fees has been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims.

namely claims:

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions.

namely:

1. Claims 1,2: A transmitting method for transmitting broadcasting station name data indicative of a broadcasting station name.

2. Claim 3: A transmitting method of a PI code in an RDS broadcasting.